United States Environmental Protection Agency
New England Office
www.epa.gov/ne
April 2003

Water Management

Parking Lot Storm Water Control Program

Summary: In 1996, urban-based Boston University initiated a unique project to protect and improve upon one of Boston's most precious natural resources, the Charles River. BU undertook this project as a Supplemental Environmental Project (SEP) to fulfill the requirements of an EPA Consent Decree. With the assistance of the Charles River Watershed Association (CRWA), Boston University (BU) studied several structural control measures or best management practices (BMPs) for removing pollutants from parking lot runoff on campus before draining into the Charles River. Engineering designs evaluated a bituminous berm system, an oil/water separator, a small detention basin, water quality chambers, and a grassy swale for the water to run through. The final engineering study compared three systems, an oil water separator and grassy swale combination, a simple grassy swale, and a water quality chamber prior to discharge into the storm drain. The end result is that through years of monitoring and reviewing lessons learned, it is possible to cost effectively deploy similar systems elsewhere.

Campus Profile

Boston University
Boston, MA
UG Students: 15,338
Grad Students: 9,906
Resident Students: 10,700
Faculty & Staff: 8,959
GSF of all buildings: 12 million
Campus Area: 132 acres
Operating Budget: $1.28 billion for FY 02
No. of Parking Spaces: 3,340

The Charles River

The Charles River, which flows between Boston and Cambridge, is one of the worlds' busiest recreational rivers. It starts 80 miles to the West and flows into Boston Harbor. The River suffers from pollution from many urban sources, but through the efforts of its upstream and downstream neighbors and caretakers, the River is becoming cleaner each year. The goal for EPA and its partners is to make the Charles swimmable by 2005. See http://www.epa.gov/region1/charles/

Project Goals & Objective

- Study the removal of silt, oil, grease and other materials from storm water and the discharge of "cleaner" water to the Charles River,
- Demonstrate methods to clean storm water runoff in an urban setting,
- Fulfill requirements of an EPA settlement.

Description of Issue/Problem

An urban college campus typically contains large parking areas with storm drains. This can cause significant environmental problems for a nearby river system. To begin resolving these issues at BU, new and innovative solutions to help clean up and maintain the River needed to be found.

Pre-Project Considerations

1. The parking lot location, elevation & geography.
2. To install a new storm drain or use a pre-existing one.
3. How water flows at the site - heavy or light, fast or slow, the direction, etc.
4. Estimated construction, operation, and maintenance costs.

Created by Campus Consortium for Environmental Excellence through EPA Funding

Steps Taken

The project was divided into three distinct tasks:

1. Develop a plan, including identification and the preliminary evaluation of possible sites on campus.
2. Implement the plan, including construction of the storm water control device(s) or BMPs.
3. Monitor the effectiveness of the BMPs, including operation and maintenance.

And included the following details:

- A team was formed consisting of employees from BU, EPA, CRWA, and the engineering consultant, Rizzo Associates.
- CRWA determined which pollutants in storm water should be analyzed during the study.
- Rizzo Associates designed the BMPs taking into account the pollutants to be analyzed.
- Various parking lots on campus were reviewed to determine the best location for the study and installation of the control systems. Seven sites were analyzed; three were chosen.
- City permits were obtained to hook up new catch basins to the city storm water system.
- The project used some parking spaces during the construction phase (and during monitoring and maintenance).
- The systems were installed by a construction company hired by the University.
- During storm events, pollutant concentrations of water quality samples were collected upstream and downstream of the systems. The percent removal for each parameter upstream and downstream was then compared.
- The units were maintained and cleaned on a regular basis.

The Systems

- At one location, slow-moving water was directed through an oil-water separator then onto a grassy knoll/swale before going onto the storm drain.
- A second location used just a grassy swale to direct water to a storm drain (*see picture at right*).
- One location had two different water quality chambers installed for comparative purposes where water passed through before going into the storm water system.

Participants

Direct BU Participants:

- Office of Physical Plant – managed the project
- Office of Parking Services – during installation and maintenance activities
- Office of Environmental Health and Safety – served in an advisory role
- Office of General Counsel

External Participants:
- US EPA (including their Drainage Expert)
- Charles River Watershed Association
- Rizzo Associates, Engineering Consultant
- Construction Contractor

Unexpected Participants:
- Licensed Site Professional (LSP) – to ensure compliance with Massachusetts environmental regulations during contaminated soil removal activities.
- Soil removal contractors – to clear the site of contaminated soil.
- Sculpture removal and replacement contractor – an important sculpture was at one of the locations and had to be moved.
- Sealcoat Company – to repave the parking lots.

Financial Info

Projected Initial Costs: $404K (as part of the SEP with EPA)
True Costs: $501K

Funding Sources:
The University – the Office of Physical Plant managed the funds.

Location #1: $20K
Location #2: $13K
Location #3: $122K

The costs for the above sites included mobilization, site prep, catch basins, the water quality chamber (at #3) $65K, supplies, and a trench drain.

Other Project Costs: CRWA monitoring, moving the sculpture, site clean up (to address the contaminated soil) and sealcoating.

Note: Each of the sites installed NEW catch basins. If pre-existing basins were used, the costs to fund the project would have been greatly reduced.

Performance and Benefits

- The grassy swale systems were much better at removing pollutants than the systems at the other sites. However, there was a slight build up in the grass consisting of sediment, debris, oil, and grease that required periodic cleaning.
- The grassy swale met the design total suspended solids (TSS) removal rate of 50%.
- The requirements set forth in the SEP were met.

Lessons Learned

- Take into account heavy rainfall which could flush the system out by installing a by-pass unit.
- Closed chambers should not be used as they are *very* difficult to maintain and clean out. They may also create a confined space situation.
- Find man-made grass-like material, as real grass needs to be replaced often and sod is expensive.
- Ensure that maintenance of the systems is taken into account during the design phase.
- Murphy’s Law does exist. One of the sites had contaminated soil and required an expensive clean up prior to moving ahead.
- Parking spaces are precious so try not to use more than one space, if any at all.
- Install units on the bottom of a slope and then berm the area to collect and direct the rainwater.
- Determine groundwater levels prior to starting the project.
- All excavation at BU was in fill, and clearing the site did not reveal any bedrock, however, the “geology” of the area must be taken into consideration.
- Work with engineers to determine the best baffle arrangement in the chambers.
- Sampling had to occur during storm events, (within one hour of the start of the rainfall), so immediate contact with the monitoring company was essential.
- Target TSS for removal because other pollutants (e.g. oil, grease, bacteria) adhere to this substrate.

For Further Information

William Costa, Director of Energy and Operations at Boston University.

Charles River Watershed Association Description of the BU Program:
http://www.crwa.org/index.html?wavestop.html&0

Clean Charles Coalition
http://www.cleancharles.org/index.shtml

CRWA SmartStorm Rainwater Recovery System:
http://www.crwa.org/index.html?wavestop.html&

The Wisconsin Storm Water Manual – Filter Strips
http://www1.uwex.edu/ces/pubs/pdf/G3691_6.PDF

Grassy Swales
http://www.oaklandpw.com/creeks/pdf/swales.pdf

Alternative Methods for Storm Water Management
http://www.cleanrivers-pdx.org/tech_resources/smm/2002%20Stormwater%20Manual/Adobe%20Acrobat%202/G)%20Chapter3-%20Alternative%20Methods.pdf

Stenciling Storm drains
http://cfpub.epa.gov/npdes/stormwater/menuofbmps/invol_6.cfm
http://www.whoi.edu/seagrant/education/stormdrain/

North Carolina Urban Water Consortiums Storm Water Group
http://www2.ncsu.edu:8010/ncsu/CIL/WRRI/stormwater/biblio.html

Other Storm Water Control Programs

- Stanford University
- University of Michigan
- University of Vermont

Commentary

If the grassy swale storm water control system was to be reproduced at another institution, or at another site at BU, costs would probably be significantly lower than reported here. Costs could be reduced because of no need to compose engineering design documents or to perform reviews, use of existing manholes, no need for soil clean up activities (hopefully), and no requirements to monitor.